REMARKS

Applicant has studied the Office Action dated March 8, 2006 and has made amendments to the claims. It is submitted that the application, as amended, is in condition for allowance. Claims 1-5 and 17-27 are pending. Claims 1, 4, 19, 21, and 23 have been amended. Reconsideration and allowance of the pending claims in view of the above amendments and the following remarks are respectfully requested.

Claims 1-5 and 17-27 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Visser (U.S. Patent No. 5,356,477) in view of Gelatos et al. (U.S. Patent No. 5,324,690). This rejection is respectfully traversed.

The present invention is directed to methods of using SACVD deposition to deposit a layer of dielectric material inside a deposition reactor during the fabrication of a semiconductor integrated circuit. According to one embodiment, there is provided a reaction chamber for carrying out SACVD deposition, and a stream of a first reaction gas containing oxygen plasma is supplied into a first gas feed conduit connected to the reaction chamber. Microwaves are applied inside the first gas feed conduit in order to produce sufficient oxygen radicals, which are necessary to initiate SACVD deposition, from the oxygen plasma. A stream of a second reaction gas is supplied into the reaction chamber through a second gas feed conduit, with the second reaction gas being suitable to initiate SACVD deposition when reacting with oxygen radicals.

The first reaction gas, in which sufficient oxygen radicals have been produced from oxygen plasma, is supplied from the first gas feed conduit into the reaction chamber to perform an SACVD deposition within the reaction chamber through reaction of oxygen radicals with the second reaction gas. Because the microwaves are applied to the first gas (containing oxygen plasma) within the gas feed conduit and then the first gas that has sufficient oxygen radicals is supplied to the reaction chamber, SACVD deposition of a dielectric layer can be accomplished without requiring the generation of ozone, while high quality gap-fill and step coverage are obtained.

The Visser reference is directed to a method for providing a substrate with a surface layer from a gas phase using a vapor. The Gelatos reference is directed to a method of forming a ternary boron nitride film for a semiconductor device. However, neither Visser nor Gelatos discloses an SACVD deposition method in which there is provided a reaction chamber for carrying out SACVD deposition, a stream of a first reaction gas containing oxygen plasma is supplied into a first gas feed conduit, microwaves are applied inside the first gas feed conduit in order to produce sufficient oxygen radicals from the oxygen plasma, a stream of a second reaction gas is supplied into the reaction chamber through a second gas feed conduit, and the first reaction gas, in which sufficient oxygen radicals have been produced from oxygen plasma, is supplied from the first gas feed conduit into the reaction chamber to perform an SACVD deposition within the reaction chamber, as is recited in amended claim 1.

Likewise, neither Visser nor Gelatos discloses an SACVD deposition method in which an oxygen plasma is supplied into a gas feed conduit connected to a reaction chamber, microwaves are applied to the oxygen plasma in the gas feed conduit, and free oxygen radicals produced in the gas feed conduit are supplied from the gas feed conduit into the reaction chamber to perform SACVD deposition, as is recited in amended claim 9. Similarly, neither Visser nor Gelatos discloses an SACVD deposition method in which a stream of oxygen is supplied to a magnetron, the magnetron is operated so as to generate within the magnetron an oxygen plasma containing sufficient free oxygen radicals to initiate SACVD deposition, and a stream of the oxygen plasma is discharged from the magnetron and supplied into the reaction chamber to perform SACVD deposition, as is recited in claim 24.

The Visser reference is directed to providing a substrate with a surface layer from a gas phase using a vapor in a device having a reactor chamber and a reservoir. The vapor is generated through evaporation of a substance in the reservoir and is conducted to the reactor chamber through a gas line. The vapor is conducted from the reservoir to the reactor chamber by a pump that is included in the gas line. Visser teaches that the vapor can be TEOS and/or other substances. However, none of the substances disclosed for use in the deposition method of

Visser includes a source of oxygen -- either as ozone or as a plasma. Instead, the deposition method of Visser is performed through heat decomposition of TEOS.

As recognized by the Examiner, Visser does not disclose applying microwaves inside a gas feed conduit in order to produce sufficient oxygen radicals from an oxygen plasma to initiate SACVD deposition. However, the Examiner has taken the position that the Gelatos reference makes up for this deficiency in the disclosure of Visser. In particular, the Examiner states that Visser provides a heater element, Gelatos discloses using an RF generator to initiate film deposition, and it would be obvious to one of ordinary skill in the art to replace Visser's heater element with the RF generator of Gelatos so as to produce the claimed invention. This position of the Examiner is respectfully traversed.

First, Applicant respectfully submits that one of ordinary skill in the art would not have had any motivation for modifying the method and device disclosed in Visser with the RF generator disclosed in Gelatos so as to produce the recited SACVD deposition methods. It is well-settled that a reference must provide some motivation or reason for one of ordinary skill in the art (working without the benefit of hindsight reconstruction using the applicant's specification) to make the necessary changes in the disclosed method. The mere fact that a reference may be modified in the direction of the claimed invention does not make the modification obvious unless the reference expressly or impliedly teaches or suggests the desirability of the modification. In re Gordon, 221 USPQ 1125, 1127 (Fed. Cir. 1984); Ex parte Clapp, 227 USPQ 972, 973 (Bd. App. 1985); Ex parte Chicago Rawhide Mfg. Co., 223 USPQ 351, 353 (Bd. App. 1984).

Some motivation for combining the different features of the Visser and Gelatos references in a specific manner must be shown in order to sustain a finding of obviousness. The Examiner's after-the-fact opinion that "it would have been obvious" to substitute the RF generator of Gelatos in place of the heater of Visser is not sufficient to make out a prima facie case of obviousness. To make a proper rejection under 35 U.S.C. § 103(a), the Examiner must establish a prima facie case using the appropriate legal standard for "obviousness". See MPEP

§ 2142-2143. There is simply no suggestion in Visser or Gelatos of combining selected features of one reference with the device of the other references in order to produce the claimed deposition methods, nor is there any suggestion of the desirability of such a combination. It is respectfully submitted that the Examiner is engaging in hindsight reconstruction of the claimed invention.

Second, one of ordinary skill in the art would not combine the Visser and Gelatos references because of their very different teachings. Visser is directed to performing deposition through heat decomposition of a substance without the presence of oxygen radicals, while Gelatos is directed to performing deposition through reaction of a substance with oxygen radicals. Because the two deposition methods are not compatible, one of ordinary skill in the art would not combine features of one reference into the other reference.

Third, in the deposition method disclosed in Gelatos, reactants are introduced into the reaction chamber and then RF is applied to the reaction chamber to produce radicals for deposition. See Gelatos at 3:20-42. Thus, combining the Visser and Gelatos references would teach one of ordinary skill in the art to apply the RF generator directly to the reaction chamber. This obviously fails to produce oxygen radicals outside the reaction chamber that are then supplied to the reaction chamber.

In contrast, in embodiments of the present invention, microwaves are applied to the oxygen plasma to produce free radicals before the plasma is supplied to the reaction chamber, and then the free radicals are supplied to the reaction chamber to initiate deposition. For example, in one embodiment microwaves are applied to the oxygen plasma in the gas feed conduit in order to produce sufficient free oxygen radicals, and the free oxygen radicals are then supplied from the gas feed conduit into the reaction chamber of the reactor to perform SACVD deposition.

Fourth, even if the RF generator of Gelatos is substituted in place of the heater element of Visser, the result would be very different than the claimed invention. A simple substitution as

suggested by the Examiner would result would only be the production of radicals that are very different from oxygen radicals (e.g., TEOS radicals). This is because Visser's method does not use any oxygen source, as explained above. Additionally, even if oxygen were somehow supplied to the gas feed conduit in the device of Visser, any production of oxygen radicals would be disadvantageous. This is because such oxygen radicals would start reacting with the remaining reactants (e.g., TEOS) inside the conduit because the device of Visser has a single feed conduit for the reaction chamber.

In contrast, in the embodiment of the present invention recited in amended claim 1, a stream of a first reaction gas containing oxygen plasma is supplied into a first gas feed conduit to which microwaves are applied to oxygen radicals, and a stream of a second reaction gas is supplied into the reaction chamber through a second gas feed conduit.

Furthermore, the present invention is directed to an SACVD deposition method. In embodiments of the present invention, there is provided an SACVD reaction chamber and an SACVD deposition reaction is performed within the reaction chamber.

Visser is not even directed to deposition through the SACVD deposition technique. Thus, Visser does not disclose the provision of an SACVD reaction chamber for use in an SACVD deposition process. Similarly, Visser does not disclose the supplying of a remote plasma containing sufficient radicals into an SACVD reaction chamber to perform an SACVD deposition reaction within the reaction chamber.

Gelatos is directed to providing a non-silyated, ternary boron nitride film for a semiconductor device. The non-silyated, ternary boron nitride film is formed through plasma-enhanced chemical vapor deposition (PECVD) using non-silyated compounds of boron, nitrogen, and either oxygen, germanium, germanium oxide, fluorine, or carbon. Gelatos is thus directed to deposition through the PECVD deposition technique, and does not even mention using an SACVD deposition technique. Thus, Gelatos also fails to disclose the provision of an SACVD reaction chamber for use in an SACVD deposition process. Similarly, Gelatos also fails to disclose the supplying of a remote plasma containing sufficient radicals into an SACVD reaction chamber to perform an SACVD deposition reaction within the reaction chamber.

Applicant believes that the differences between Visser, Gelatos, and the present invention are clear in amended claims 1, 19, and 24, which set forth methods of using SACVD deposition in accordance with various embodiments of the present invention. Therefore, claims 1, 19, and 24 distinguish over the Visser and Gelatos references, and the rejection of these claims under 35 U.S.C. § 103(a) should be withdrawn.

As discussed above, claims 1, 19, and 24 distinguish over the Visser and Gelatos references, and thus, claims 2-5, 17, and 18, claims 20-23, and claims 25-27 (which depend from claims 1, 19, and 24, respectively) also distinguish over the Visser and Gelatos references. Therefore, it is respectfully submitted that the rejection of claims 1-5 and 17-27 under 35 U.S.C. § 103(a) should be withdrawn.

In view of the foregoing, it is respectfully submitted that the application and the claims are in condition for allowance. Reexamination and reconsideration of the application, as amended, are requested.

If for any reason the Examiner finds the application other than in condition for allowance, the Examiner is invited to call the undersigned attorney at (561) 989-9811 should the Examiner believe a telephone interview would advance the prosecution of the application.

Respectfully submitted,

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